

The Best Aircraft for Close Air Support in the Twenty-First Century

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Introduction and Background

In a presentation to a Senate-led defense appropriations hearing, the incumbent Air Force secretary, Deborah Lee James, painted a very grim picture in the face of economic sequestration. "Today's Air Force is the smallest it's been since it was established in 1947," she explained, "at a time when the demand for our Air Force services is absolutely going through the roof."¹ Because of far-reaching governmental budget constraints, the Air Force is being forced to make strategic decisions regarding the levels of manning and aircraft to maintain tactical readiness. In 2013 the service responded to a \$12 billion budget reduction by cutting nearly 10 percent

of its inventory of aircraft and 25,000 personnel, necessitating the reduction of flying squadrons and overall combat capability.² With sequestration scheduled to last until 2023, however, the budget shows no sign of being restored any time soon. Consequently, Air Force senior leaders must continue to make tough decisions.³

A number of military experts have proposed eliminating less important “mission sets” by retiring aging airframes and replacing them and their single-role effectiveness with multirole aircraft.⁴ To meet mounting budget demands, the Air Force chose the A-10 Thunderbolt as the first aircraft to place on the budgetary chopping block. This exclusive air-to-ground asset specializes in delivering multiple forms of munitions to provide close air support (CAS) and protect ground operations. Highlighting the potential savings of \$4.2 billion in operations and sustainment costs, Gen Mark Welsh, the former chief of staff of the Air Force, wanted to reinvest those savings in multirole aircraft like the F-35 that “can not only do CAS, but can also survive in a high-end fight.”⁵ He argued that the F-35 is just as capable as the A-10 in delivering CAS and that it offers more incentives, such as fewer operating hours, stealth capabilities, and enhanced speed.

On the battlefield, CAS will continue to be an essential mission. Additionally, modern-day counterinsurgency operations require precision engagement of enemy forces to protect friendly forces on the ground, prevent fratricide, and minimize collateral damage.⁶ Munitions dropped off target can wreak havoc in civilian populations, killing innocent people and hurting campaign support. Because CAS plays such a critical role in combat operations, the Air Force must ensure that it has capable aircraft that can sustain CAS operations in the face of budgetary crises. The service’s senior leaders believe that after they retire the A-10 in 2019, the F-35 will have become fully operational and a capable replacement, working alongside legacy aircraft (like the F-16) to conduct CAS in future operations.⁷ In an environment where every second counts and multiple air assets can be called on at a moment’s notice, can the F-35 and other legacy systems really deliver the same level of performance as their predecessor? Will retiring the A-10 actually save the money needed to meet Air Force sustainment costs if other platforms are asked to perform the same roles?

This article examines the following question: Which aircraft (or combination of platforms) is the best option to lead and sustain the Air Force’s CAS capability in the twenty-first century? To answer this question, the article evaluates a variety of aircraft that perform CAS in modern-day operations, based on the service’s requirements outlined above. However, one must first operationally define the role of CAS in this study. Joint Publication 3-09.3, *Close Air Support*, denotes it as “air action by fixed-wing . . . and rotary-wing . . . aircraft against hostile targets that are in close proximity to friendly forces[, requiring] . . . detailed integration of each air mission with the fire and movement of those forces.”⁸ In addition to CAS, the Air Force employs its aircraft to perform a myriad of roles during combat operations, such as offensive counterair, defensive counterair, suppression of enemy air defenses, destruction of enemy air defense, combat search and rescue, and so on. However, to make the comparison simpler and easier to quantify, this article aligns those operational roles into three distinct categories: air superiority, air interdiction, and CAS. Despite the evolution of airpower doctrine over time, these basic categories have remained an order of operations for air-lead joint campaigns; this study concerns itself only with

CAS. The basic idea is that air superiority missions would start by eliminating any threat to air operations, such as antiaircraft weapons or enemy aircraft. Second, air interdiction would involve strategic air-to-ground engagement, targeting command, control, and communications nodes and positioned enemy forces. Finally, CAS would involve aircraft support to friendly ground forces, specifically supporting troops in contact with enemy forces. This definition of CAS is more specific than the joint version and offers a better picture of what is expected from a solid CAS platform: precision engagement of enemy forces in close proximity to friendly forces conducting ground operations. This denotation, though brief, summarizes what joint doctrine characterizes as effective CAS. The following conditions, when employed concurrently, increase the effectiveness of CAS: effective training and proficiency of aircrews and joint terminal attack controllers, command and control to achieve air-to-ground integration, air superiority to allow unrestricted access to target sets, target marking to avoid friendly fire and minimize collateral damage, streamlined and flexible procedures to expedite responsiveness, appropriate ordnance, and consideration of environmental conditions.⁹ To further improve CAS responsiveness, the following techniques are also applied: deployment of CAS assets and personnel to forward operating locations for increased response and longer pattern-loiter duration, placement of aircrews and aircraft on alert status, delegation of authority to the lowest tactical level, and integration of joint terminal attack controllers and air liaison officers with ground units to streamline continuous command, control, and communications.¹⁰

Long before the Air Force began operating in the current state of perpetual budgetary trimming, the service's comptrollers analyzed and calculated complex algorithms and equations to predict budget proposals used every fiscal year. One such calculation is the annual cost per flying hour (CPFH), which tracks and analyzes operational and support costs maintained in a cumulative database called the Air Force Capability Assessment Program.¹¹ A report published in 1999 by the United States General Accounting Office noted that the Air Force had issues with flying its requested number of annual flying hours.¹² In an effort to become more efficient, each major command adopted a standardized methodology for tracking its flying-hour program, allowing for a more accurate request based on requirements specific to the major command. The first step to tracking a flying-hour program is determining a unit's sortie requirements, including the following factors: number of line pilots needed for combat mission readiness, experience level of pilots assigned (less experience necessitates more sorties), number of attached pilots fulfilling outside roles required to maintain basic mission-capable status, special mandatory capabilities (e.g., functional check-flight certifier or instructor pilot), and collateral sorties (e.g., ferry flights, deployments, and incentive flights).¹³ After sortie requirements are tallied, they are converted to flying hours by using sortie duration estimates based on historical averages. Sortie duration will vary according to geographic location, aircraft type, aircraft configuration, aerial refueling, distance to bombing ranges, and so forth.¹⁴ Once these figures are accumulated for each major command's fleet, the second step is developing a CPFH rate based on three types of maintenance and operations expenditures: depot-level repairable parts (e.g., engines or avionics line-replaceable units that can be repaired at maintenance facilities),

consumable supplies (nonrepairable supply items), and aviation fuel.¹⁵ Once the flying hour rate and number of hours are determined by type of aircraft, the actual CPFH can be ascertained for use in this analysis. This information, although not widely disseminated, is calculated and made available by the Air Force's financial management and comptroller. This data is valuable to this study because the CPFH provides a dollar figure estimate to the actual costs of sustaining operations with a specific type of aircraft. Since budget constraints are the leading reason for retiring the A-10 in favor of multirole platforms, factoring actual CPFHs will reveal the more cost-effective option. All CPFH data used in this study for aircraft comparison comes from the comptroller's Air Force Capability Assessment Program database, released in 2013.¹⁶

To be as comprehensive as possible, this article reviews all of the aircraft that perform CAS in today's Air Force: AC-130s, remotely piloted aircraft (RPA), light attack aircraft (LAA), legacy fighter aircraft (F-16s and F-15s), F-35s, and A-10s. The criteria for evaluating these aircraft are based on the following considerations: design, fleet age, upgrades, capabilities, hardware, CPFH, stores capacity, range, speed, and time on target.

Attack helicopters like the Apache and Cobra have historically been used by the Army and Marine Corps for CAS, but they are not considered in this comparison for two reasons. First, although the Air Force currently has a small fleet of rotary-wing aircraft, they do not perform CAS in the traditional sense. The fleets of HH-60 Blackhawks employed in combat operations are limited to combat search and rescue operations, generally using small-arms fire to provide cover and conceal the deployment or retrieval of special forces personnel on board. Acquiring aged airframes from other services, standing up new operations and maintenance squadrons, or building the infrastructure necessary to accommodate them would be neither cost effective nor advantageous. Second, in the wake of the failed Comanche project (involving a stealth helicopter, cancelled because of budget cuts in 2004), the Army wants to replace its rotary-wing aircraft. Starting in 2009, that service initiated "future vertical lift," a modernization project to replace the Chinook, Blackhawk, and Apache helicopters by 2030.¹⁷ Since the earliest prototypes are not predicted to be available until 2017, replacing combat-capable aircraft with modern attack helicopters will not be an option in the near term.¹⁸ The combination of these two factors alone eliminates the helicopter as a viable source for Air Force CAS.

Neither are large-scale heavy bombers (the B-52, B-1, and B-2) included in this report although they are some of the oldest and most battle-proven aircraft in the Air Force inventory. The CPFH for bombers is too high to employ them without predetermined target sets, on the off chance that they fly and refrain from delivering munitions. Simply put, they are too expensive to loiter around and wait for CAS engagements. The B-1 is the most frugal of the three, costing \$58,000 per hour.¹⁹ That figure is more than twice the cost per hour of the F-16C and nearly three-and-a-half times that of an A-10.²⁰ The B-52 comes in second, with a price tag of almost \$70,000 per hour.²¹ Finally, the B-2, with its complex, low-observable profile and \$2-billion-per-aircraft price tag, tips the scales at a massive \$169,000 per hour—more than twice the rate of any other aircraft.²² With the capability of these platforms to carry large stores of munitions, their ability to conduct precision engage-

ment of multiple targets simultaneously during one sortie, and their high operating costs, the CAS role for B-1, B-2, and B-52 bombers should be constrained, and the service should utilize these aircraft primarily for air interdiction and nuclear operations.

The AC-130 has been a reliable platform for the Air Force's special operations community since the original prototype was designed and built in 1953. The AC-130H uses a 40 millimeter (mm) cannon and a modified M102 Howitzer 105 cannon, both mounted in the side, while the AC-130U employs a 25 mm Gatling gun in place of the 40 mm cannon.²³ Programmed with more than 609,000 lines of software code to run its avionics and mission computers, the aircraft is also outfitted with a myriad of sophisticated targeting and navigation sensors to ensure tremendous accuracy: "During Vietnam, gunships destroyed more than 10,000 trucks and were credited with many life-saving close air support missions."²⁴ Furthermore, because it has the fuel capacity of a standard C-130, it enjoys a range of 1,300 nautical miles, allowing for increased loiter and time on target.²⁵ Despite these benefits, however, AC-130s were produced in small numbers, with only 8 H-models and 17 U-models in the Air Force inventory. Additionally, the AC-130 is a dedicated special operations forces asset, called on to deploy around the globe at a moment's notice. The combination of these two factors limits the Air Force's ability to rely on their availability in the joint environment and to employ them in CAS for standard operations. Although the new AC-130J can deliver standoff precision-guided munitions like the GBU-39 small diameter bomb and the AGM-176 Griffin missile, it is still in operational test and development.²⁶ The new squadron (replacement for the H and U models) is not slated to begin operations until fiscal year 2017, and, like its predecessor, it will also be produced in limited numbers.²⁷ Despite being a proven platform for CAS, its dedication to special operations forces, fleet age, and small numbers prevent it from being a candidate in this study. Thanks to a recent event in Jordan, however, the development of future gunship platforms could be on the horizon. Contracts between the King Abdullah II Design and Development Bureau of Jordan and Alliant Techsystems Incorporated were established to convert CASA 235 and 295 medium-range aircraft to gunships, using removable weapons and component guidance systems.²⁸ Though not included in this study, if this procurement project turns out to be a viable and cost-effective future option, there may be more talk of gunship CAS in the near future.

RPAs have emerged throughout the armed forces as versatile aircraft, used in military operations primarily for intelligence, surveillance, and reconnaissance (ISR) operations. RPAs such as the MQ-1 Predator and the MQ-9 Reaper have been employed around the globe, supplying real-time illumination of battlefield operations and providing much-needed intelligence for mission planning as well as on-going mission operations. But recently, RPAs have been given a second mission that the Air Force describes as dynamic target execution: "Given its significant loiter time, wide-range sensors, multi-mode communications suite, and precision weapons—it provides a unique capability to perform strike, coordination, and reconnaissance against high-value, fleeting, and time-sensitive targets."²⁹ Essentially, since RPAs are constantly monitoring the battlespace in a real-time environment, they are superb candidates for eliminating short-notice targets of opportunity.

Ideally, these same traits would classify RPAs as prime candidates for CAS opportunities. The capabilities that allow RPAs to fly without pilots on board, however,

limit their reliability. In the last 14 years, large RPAs used by the US military have been involved in more than 400 crashes and major accidents.³⁰ The high number of incidents compared to those for aircraft with pilots in the cockpit can be attributed to four main factors: a lack of detection and avoidance technology, unreliable communications links, mechanical defects, and pilot error.³¹ Simple interference caused by weather and bandwidth can have devastating effects; sensors, cameras, and complex avionics and guidance systems can never replace the eyes, ears, and nose of a human piloting an aircraft.³² One example comes during operations in Afghanistan, where an inexperienced pilot accidentally flew a Predator into the side of a mountain while helping troops on the ground.³³ Granted, mechanical defects can occur on any aircraft at any time, and given human nature, pilots in the cockpit make errors too. However, a pilot in a fighter aircraft will still be able to control that aircraft and avoid midair collisions because he or she does not require communications to control the platform. Although they are aptly suited for ISR and the destruction of dynamic targets, RPAs' inherent potential for unreliability from relatively minor factors during critical operations and high demand in current ISR roles make them a poor choice for dedicated CAS missions and support.

Qualitative Assessment and Relevant Information

Light Ground Attack Aircraft

Despite General Welsh's intent to modernize the Air Force with multirole aircraft, many experts believe that fielding lighter, more cost-effective, propeller-driven aircraft is a viable CAS option. Though many aircraft could fit in this category, this article uses Beechcraft's AT-6 for comparison since it is currently employed by the US Air Force, US Navy, and services of eight other nations. The platform was originally purchased for training purposes, but Beechcraft has created variations such as the AT-6B that the company says are capable of performing a wide variety of missions: counterinsurgency, CAS, forward air control, combat search and rescue, armed reconnaissance, airborne interdiction, civil support, disaster response, maritime patrol, and border security.³⁴ Equipped with a glass cockpit (multiple large multifunction displays and digital instruments), infrared cameras, laser capabilities (designator, illuminator, and range finder), and six weapons pylons, the AT-6B is a modern variant of the T-6A that the US Air Force uses for training.³⁵

The T-6 has been fielded since May 2000, so the supply chain is already established and would be available for this relatively new fleet of aircraft, purchased straight off the production line.³⁶ CPFHs of newly purchased aircraft would be extremely low initially due to warranty considerations, rising to approximately \$2,500/hour based on T-6A averages from 2009–13.³⁷ Another low-cost benefit is the overall expense per aircraft. The original T-6A cost as little as \$4.2 million, but despite robust cockpit upgrades, avionics, and weapons pylons, the AT-6B is estimated to come in at only \$8–10 million.³⁸ The stores capacity is humble compared to that of legacy aircraft. Despite its six stations and maximum load capacity of roughly 3,000 pounds, the standard configuration would range from 1,500 to 2,000 pounds,

consisting of 250-/500-pound laser-guided bombs, rockets, Hellfire missiles, or .50 caliber gun pods in order to maintain long-term loiter rates without refueling.³⁹ The employment of external fuel tanks for longer loiter times would reduce that number considerably to 1,000 pounds. Comparing such light aircraft to legacy aircraft, one sees that “the F-16 C/D carries 2,000 pounds of ordnance when loaded with 500-pound class munitions and 4,000 pounds when carrying larger 2,000-pound class munitions,” whereas “the F-15E carries from 6,000 to 10,000 pounds, and the A-10 can carry up to 10,000 pounds of ordnance, during standard combat sorties.”⁴⁰ The speed of the AT-6B is approximately 280 knots with a range of 900 nautical miles, giving it hours of loiter time without fuel tanks.⁴¹

Although the propeller motor allows longer range and loiter time with lower fuel consumption, compared to jet aircraft, the AT-6B's speed makes it more vulnerable to attack. A report by the Joint Chiefs of Staff in 1968 noted that “propeller aircraft had experienced loss rates up to five times higher than those of jet aircraft.”⁴² Although this report seems dated in its application to this study, since the Vietnam War, one finds few modern studies that analyze the loss rates of propeller-driven aircraft in war. This fact is largely due to the proliferation of jet engine technology, which replaced propeller-driven fighters/bombers with jet-driven variants, as witnessed during both the Korean and Vietnam wars. In Vietnam, for example, the only propeller-driven bomber aircraft, the A-1, was inevitably phased out by 13 different jet-engine-driven aircraft (the A-3, A-4, A-5, A-6, A-7, F-4, F-5, F-8, F-100, F-101, F-102, F-104, and F-105). Additionally, unlike most legacy aircraft systems, no variants of the T-6 are equipped with a radar warning receiver, which evaluates inbound threats to the aircraft. Consequently, the optimal air environment for the AT-6B would be uncontested with minimal enemy surface-to-air munitions or air-to-air threats. However, once air superiority is established, the AT-6B becomes an economic asset for CAS because propeller-driven aircraft like the T-6 were reported by the joint chiefs to be “nine times as effective as jet aircraft per sortie” in airborne interdiction and CAS missions such as destroying “trucks and watercraft” on the ground.⁴³ The slower speeds of propeller aircraft allow for better targeting, positive identification of forces (both enemy and friendly), and an increased chance of effective munitions employment. Couple those rates from 1968 with the upgraded cockpit, a modern Helmet Mounted Cueing System for targeting (comparable to that of legacy and next-generation aircraft), various data links (e.g. Link 16) and radios (e.g., UHF, VHF, and satellite communications), and night vision goggle compatibility, and the AT-6B proves to be a legitimate weapon for CAS.

A final consideration for implementation of the AT-6B is the ease of allocating money to pay for the new airframe. According to a study conducted in 2009 by Maj Steven Tittel, the cost savings in daily aerial refueling realized by replacing a squadron and a half of legacy aircraft (F-16s and F-15s, specifically) conducting operations in Iraq and Afghanistan with the AT-6B would pay for the acquisition of 36 LAAs.⁴⁴ Additionally, once the Air Force has acquired a predetermined number of LAAs, it would be able to roll those savings into other programs hit with budget cuts, increasing the service's capability in other areas. The only limiting factor is the operational environment since a fully laden T-6 has a ceiling of only 25,000 feet.⁴⁵ In a high-altitude environment like Afghanistan's (average altitude levels

range between 12,000 and 15,000 feet mean sea level), LAAs are at a greater risk from threats such as man-portable air defense systems despite a preestablished no-fly zone or air superiority construct.⁴⁶

To summarize, since the AT-6B has extremely limited air-to-air defenses and thrives in an uncontested air-to-ground environment, the LAA cannot be a complete replacement for current fighter platforms. However, the LAA—like the AT-6B—is incredibly capable of providing CAS with a decent number of munitions for a fraction of the cost to operate, compared to its competitors. Capable of long ranges and high rates of time on target with minimal fuel, the LAA has the ability to loiter and employ various munitions, making it a terrific addition to the Air Force's CAS arsenal, especially in a time of reduced budgets.

Legacy Fighters: F-16/F-15/A-10

The three most prominent airframes for conducting CAS in Operation Iraqi Freedom and Operation Enduring Freedom were the F-16C, F-15E, and A-10. Although they were designed and fielded in the same generation, their capabilities vary considerably. Further, they share similar experience in combat and are thus candidates for being compared to each other and to suggested replacements like the LAA and the F-35.

The easiest way to differentiate among the three aircraft is by size and stores capability. All three can carry the same munitions (e.g., AGM-65s, guided bomb units [GBU], and missiles), but they can carry them in different numbers, increasing by aircraft in correlation with wingspan. The F-16, the smallest of the three, is able to carry only 4,000 pounds of munitions.⁴⁷ Increasing in wingspan from 10 meters (m) to 13, the F-15E can handle 6,000 to 10,000 pounds.⁴⁸ With a wingspan of 18 m (the only aircraft among the legacy fighters that is wider than it is long), the A-10 dwarfs the other two, carrying a maximum load of 16,000 pounds.⁴⁹

The fleet ages of the A-10 and F-16 are similar; the first production models were introduced to the Air Force in 1975 and 1979, respectively, and have been used extensively in combat operations since then. The F-16 proved its capability as a multi-role fighter by performing suppression of enemy air defenses, offensive counterair, defensive counterair, CAS, and forward air controller missions in Operation Allied Force—and by flying more sorties than any other aircraft in Operation Desert Storm.⁵⁰ The A-10 has also seen considerable combat time, flying in more than 10 operations, including several unit deployments to Afghanistan and Iraq to perform CAS to support ground operations.⁵¹ The F-15C and D models were introduced the same year as the F-16, but the Strike Eagle F-15E did not come to the Air Force until 1988.⁵² Designed as a dual-role air-to-air and air-to-ground fighter, the F-15E shares little more than a basic design structure with its predecessors.⁵³ With a stronger landing gear, conformal fuel tanks, a specialized rear cockpit for a weapons officer, and low-altitude navigation and targeting infrared for night (LANTIRN) capability, the F-15E is well suited for the CAS environment. Moreover, because it was designed and released almost 10 years after the F-16 and A-10, its fleet average number of flying hours is lower. Unlike the A-10, both the F-15E and the F-16 are owned by other militaries, allowing for a larger pool of parts and interagency support.

The A-10's claim as a dominant CAS platform comes from its very design. Created specifically for the role of supporting ground troops in combat, the plane was built around a 30 mm Gatling gun fired from the nose of the aircraft.⁵⁴ Its engines were mounted on top of and outside the fuselage, permitting the A-10 to operate in austere conditions and dirt runways—and to keep them away from internally stored fuel in the case of battle damage.⁵⁵ Additional protection from small-arms fire includes fuel tanks lined with a fuel-activated congealing agent; redundant flight controls; nonhydraulic, redundant flight control systems; and a titanium bathtub to protect the pilot.⁵⁶ One drawback, compared to its counterparts, is that the A-10 lacks a radar warning receiver—useful for assessing air-to-air threats. However, the entire A-10 fleet was upgraded in 2007 to the A-10C designation, denoting newer communications, countermeasures, navigation, and display equipment in the cockpit.⁵⁷

In addition to weight, the A-10 has the largest stores-carrying capacity. With 11 pylons, it is the most configurable of the airframes and can be used in conjunction with triple ejector racks and dual rail adapters to increase the number of bombs and missiles (respectively) held on each pylon. In a common combat configuration, this capability allows the A-10 to carry dual air-to-air missiles and electronic countermeasures for protection, without sacrificing its air-to-ground payload. The F-15E has seven pylons for mounting munitions, with additional stations for hanging only missiles. The F-16 has nine stations, but the two on the wingtips are capable of hanging only missiles while two more are often dedicated to holding wing tanks to increase range and sortie duration for CAS missions. Bullet quantities are a similar story. Both the F-15 and F-16 fire 20 mm rounds from the shoulder of the aircraft and can hold only 500 rounds in their internal gun drums.⁵⁸ The A-10's cannon, however, is in a league of its own. Not only does it carry 1,150 rounds of 30 mm ammunition in its internal drum (a larger quantity of higher caliber munitions) but also its ammo load contains depleted uranium armor-piercing rounds. These rounds, mixed with traditional high-explosive incendiary rounds, make the A-10 more effective against tanks and highly armored vehicles than the other platforms.

The cost to operate the A-10 is the lowest of the three legacy fighters; indeed, at \$20,000 per flying hour, it is the cheapest of all the fighter aircraft in the Air Force inventory.⁵⁹ Prior to the upgrade to C-model designation, the total cost was almost \$5,000 per hour cheaper than the current rate.⁶⁰ The F-16 is a close second, coming in at \$23,000 to operate per flying hour, making it an economical option for a multirole/dual-mode aircraft. At \$40,000, the F-15E is incredibly expensive compared to the other two but is the same price to operate as the older F-15C and D models.⁶¹ That fact makes it a viable option for replacing the F-15C in a budget-constrained environment that emphasizes multirole aircraft and capability. One should note that the CPFH of the T-6A trainers is only \$2,500.⁶² Since the purchase price of the AT-6B is twice that of a T-6A, this article assumed that the CPFH to operate the AT-6B would be double the price. Even so, at that price, eight AT-6Bs cost as much per hour as one F-15.

In terms of speed, the two multirole jet-engine aircraft are the fastest: the F-15E can reach speeds of over 1,600 knots (Mach 2.5), and the single-engine F-16 can attain a more modest 1,300 knots (Mach 2).⁶³ Equipped with dual turbo-fan engines, the A-10 is much slower; unable to break the sound barrier, the A-10 has a maxi-

imum speed of a humble 400 knots.⁶⁴ Having the largest wings in the group, however, it is more maneuverable at those speeds.⁶⁵ Thus, the A-10 is capable of flying lower, making it better at identifying friendly and enemy forces on the ground to prevent collateral damage and “friendly fire” incidents.⁶⁶ The A-10 is the only aircraft designed to absorb small-arms fire with little risk to the aircraft, making it more effective at low altitudes. In addition to electronic countermeasures and munitions, the A-10 boasts self-sealing fuel tanks in the wings and a titanium bathtub to protect the pilot (mentioned previously), ultimately ensuring the aircraft’s ability to return from battle intact. Capable of operating safely at lower altitudes, the A-10 can fly below clouds and inclement weather, allowing for target engagement in any conditions.⁶⁷ Although faster speeds permit fighter aircraft to respond more quickly to an emergency troops-in-contact situation, slower speeds also give the A-10 longer loiter times, which translates directly to increased battlefield coverage and precision engagement with traditional (fractionally less expensive, not enabled by the Global Positioning System) munitions.

Fuel savings from the turbofan engines give the A-10 more time in the air to loiter and fly. With a range of 2,240 nautical miles, it can fly nearly two-and-a-half times farther than the AT-6B.⁶⁸ Consequently, the A-10 can loiter for several hours without refueling. With a ceiling of 45,000 feet, it eclipses the AT-6B in terms of high-altitude combat capability.⁶⁹ The range for the F-15E is a close second at 2,100 nautical miles, which varies, depending on speeds traveled. The range of the F-16 is 1,740 nautical miles, and the aircraft can fly for almost three hours if ferrying speeds are kept to about 300 knots.⁷⁰ Roughly 500 knots is “a realistic response speed,” however, giving F-16s roughly 45 minutes over target and requiring frequent refueling to loiter for longer periods of time.⁷¹ The ceiling for the F-15 and F-16 is higher than that of the A-10 but is not influential in this comparison since the main focus is on ground engagement and anything above 40,000 feet would provide a similar capability.

Of the legacy fighters, the A-10 distinguishes itself from the rest as the best aircraft for providing ground support. Featuring a lower CPFH, lower speeds and altitude capability, longer loiter times, large capacity for stores, and redundant ground-threat-specific systems to protect both the airframe and its pilot, it lives up to its reputation as a platform built with one objective: providing CAS.

F-35

Senior Air Force officials have designated the F-35 as the A-10’s replacement.⁷² A multirole fighter similar to the F-16, the F-35 represents the next generation of fighter aircraft, promising upgraded capability and the latest in stealth technology. Lockheed Martin has seen several setbacks, including engine issues and structural cracks, in this nearly \$400 billion program that has been in development for more than 12 years. In fact, the company has spent \$170 million of its own money to cut government costs.⁷³ However, the acquisition timeline is on track, and 130 aircraft have been delivered to customers as of April 2015.⁷⁴ Preceded by the air-to-air-dominant F-22, the F-35 is the second fifth-generation fighter produced by Lockheed Martin, “optimized to be a multirole fighter, with the ability to perform air-to-air, air-to-

ground and intelligence, surveillance and reconnaissance (ISR) missions.”⁷⁵ Only time will tell if it can perform CAS better than the legacy fighters.

Characteristics that set the F-35 apart from these fighters are advanced integrated avionics, advanced sensors, stealth capabilities, “enhanced situational awareness,” and autonomic logistics.⁷⁶ Since it is a new aircraft, the fleet age and average hours will be the lowest possible; however, its newness allows for spontaneous issues and malfunctions unforeseen through development and testing. Unlike the AT-6B, the F-35 is not based on a previously flown aircraft. Since CPFH calculations have yet to be determined for the F-35, this article assumed that they are close to those of the now fully operational F-22 because of the aircraft’s similarities (i.e., both are produced by Lockheed Martin and are fifth-generation stealth fighter aircraft). Although the cost for one hour started at more than \$2.5 million during initial fielding, the F-22’s CPFH is now roughly \$70,000.⁷⁷ If the same holds true for the F-35, providing CAS will become a much more expensive endeavor compared to similar costs for the current fleet of fighters.

In terms of stores capability, the F-35 ranks higher than any other fighter, weighing in at 18,000 pounds.⁷⁸ The combination of advanced and conventional munitions is nearly identical to that of the F-16, with an internal shoulder-fired 25 mm gun replacing the F-16’s 20 mm cannon. The one caveat, however, is that carrying more than 5,000 pounds of munitions is impossible without the use of external pylons because the standard configuration for the internal weapons bays is two 2,000-pound bombs and a pair of AIM-120 missiles.⁷⁹ Carrying additional munitions then limits the capability of the F-35 as a stealth aircraft since the increased surface areas and shapes change the radar signature of the aircraft. To be at all competitive with the A-10 in terms of conducting CAS, the F-35 will have to perform more like an F-16, increasing the price of operations threefold.

The standard load of the F-35 is internal only, limiting the amount of fuel it can accommodate without the use of external stores on each wing. The lack of externally stored fuel thus constrains the range of the F-35 to roughly 1,200 nautical miles—300 more than the AT-6B but 500 fewer than the F-16.⁸⁰ Range limited by stealth nixes the F-35’s capability to provide CAS without constant refueling and a limited supply of munitions. Although it will be capable of conducting CAS for missions requiring stealth, the cost of operations will be higher, and the amount of support will be considerably lower than that in an environment where air superiority is in effect. Therefore, deploying the F-35 in a stealthy configuration adds costs if they are not truly required for mission success. For these types of scenarios, one would assume that the AC-130 would be a better candidate because it is already employed in special operations requiring more covert reinforcements, it carries much greater quantities of fuel for longer loiter capability, and it can deliver large quantities of ammunition while maintaining standoff distance. The speed of the F-35 is also mediocre when compared to that of other fighters; according to Lockheed Martin, the speed of a fully loaded, internally configured aircraft is only 1,050 knots (1.6 Mach)—250 and 550 knots slower than the F-16 and F-15E, respectively.⁸¹ The benefit of having a slightly faster response time than the A-10 is overshadowed by a minimal loiter capability caused by shorter range and limited fuel stores when responding to a troops-in-contact scenario.

Recommendations/Conclusion

This comparative analysis has demonstrated that the A-10 outshines its competitors, mainly because it is the only modern aircraft built for the attack role. It was purposely designed and constructed to offer unprecedented ground support with special considerations to protect it from battle damage while performing low-altitude missions. For example, despite lacking a radar warning receiver system, it stands out by being the only aircraft completely operational from a dirt runway. Demands for CAS in Iraq and Afghanistan kept the A-10 as a relevant platform requiring upgrades, so a service life extension program was completed to rebuild and strengthen wing and structural components in order to “safely and effectively fly the A-10 to 16,000 flying hours or beyond 2028.”⁸² Additionally, C-model upgrades to avionics components and a \$1.6 billion contract to modernize and sustain precision engagement and parts availability through Thunderbolt Lifecycle Program Support Prime Integration give the A-10 logistics support comparable to that of newer airframes.⁸³ Although the F-35 represents the latest technology and potential capability, being a multirole platform constrains its effectiveness, and its main feature (stealth capabilities) becomes impaired during heavy-loaded CAS operations.

Given the ever-present need for CAS on today's battlefield, the Air Force needs to keep the A-10. Phasing out an entire mission design series that outperforms its competition in close-quarters air support prematurely retires an unmatched CAS capability that is available for more than a decade. Supporting the phaseout of the A-10 with a multirole next-generation fighter that has yet to be field tested is a bad idea; the F-35's statistics and specifications prove it is a mediocre CAS option compared to other multirole fighters—and it comes with a \$400 billion price tag. The Air Force would be better served to reinvest 1 percent of what is being spent on the F-35 program to keep the A-10, especially after recently reinvesting millions of dollars to upgrade its service life and improve performance. It would also be prudent to purchase LAAs to reduce the overall operating costs of daily CAS coverage during war; an acquisition program with the appropriate budgeting would end up paying for itself. Furthermore, although they are aged compared to the F-35, the F-16 and F-15E continue to perform well in the multirole arena, justifying yet again the procurement of fewer F-35s.

The best aircraft for CAS in the Air Force is not a multirole fighter. CAS is better provided by a specialized aircraft with a mix of other specialized and multipurpose aircraft to support operations. At present, the best aircraft for CAS is the A-10. From a financial perspective, it does not make sense to retire this airframe after investing so much money to upgrade it to sustain operations for the next 14 years—especially since the same mission will cost nearly three times as much when performed by an F-35.

If the United States wants to continue to dominate the skies, it will need several unique aircraft to perform particular tasks as well as pilots who continue to be proficient in those specialties. Reducing overall capability and settling on newer “jack-of-all-trades” aircraft only restricts a commander's ability to complete the mission. By reducing capability, the Air Force leaves itself (and the Soldiers, Sailors, and Marines it supports) vulnerable to degraded functionality—a potentially lethal scenario

when it comes to supporting ground combat operations and effectively avoiding collateral damage. ★

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